






External and gastrointestinal parasites of the Franklin's Gull, *Leucophaeus pipixcan* (Charadriiformes: Laridae), in Talcahuano, central Chile

Parasitas externos e gastrointestinais da gaivota de Franklin *Leucophaeus pipixcan* (Charadriiformes: Laridae) em Talcahuano, Chile central

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Abstract

Parasitological studies of the Franklin's gull, *Leucophaeus pipixcan*, are scarce, and knowledge about its endoparasites is quite limited. In order to describe its parasitic community, a total of 60 Franklin's gulls were captured in the coastal area in central Chile, using modified Bal-chatri traps. Ectoparasites were collected from all 60 live individuals through inspection of their plumage, while 30 were examined for endoparasites by standard parasitological necropsy. The prevalence of ectoparasites was 78.3%, including the feather mite *Zachvatkinia larica* (43.3%) and four species of lice: *Actornithophilus piceus lari* (15.0%), *Austromenopon transversum* (6.7%), *Quadriceps punctatus* (10.0%) and *Saemundssonina lari* (46.7%). Some 25 of 30 (83.3%) of birds necropsied were parasitized with the following helminths: *Aporchis* sp. (6.7%), *Tetrabothrius cylindraceus* (56.7%), Cyclophyllidea gen. sp. (3.3%), *Profilicollis altmani* (56.7%), *Eucoleus contortus* (10.0%), *Cosmocephalus obvelatus* (13.3%), *Paracuaria adunca* (10.0%), *Stegophorus* sp. (3.3%) and *Tetrameres skrjabini* (3.3%). To our knowledge, with the exception of *P. altmani*, these helminths are reported for first time in the Franklin's gull.

Keywords: Acari, seabirds, helminths, Phthiraptera, Laridae.

Resumo

Existem escassos estudos de parasitismo em gaivota-de-Franklin *Leucophaeus pipixcan*, e o conhecimento sobre seus endoparasitas é ainda mais limitado. Com o objetivo de descrever sua comunidade parasitaria, um total de 60 gaivotas-de-Franklin foram capturadas usando-se armadilhas Bal-chatri numa zona costeira do centro do Chile. A pesquisa de ectoparasitas foi realizada em todos os indivíduos capturados e, para os endoparasitas, foram examinados 30 deles por necropsias. A prevalência de ectoparasitas foi de 78,3%, incluindo o ácaro de pena *Zachvatkinia larica* (43,3%) e outras quatro espécies de piolhos, *Actornithophilus piceus lari* (15,0%), *Austromenopon transversum* (6,7%), *Quadriceps punctatus* (10,0%) e *Saemundssonina lari* (46,7%). Das aves necropsiadas, 83,3% estavam parasitadas por helmintos, sendo registrados *Aporchis* sp. (6,7%), *Tetrabothrius cylindraceus* (56,7%),

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Cyclophyllidea gen. sp. (3,3%), *Profilicollis altmani* (56,7%), *Eucoleus contortus* (10,0%), *Cosmocephalus obvelatus* (13,3%), *Paracuaria adunca* (10,0%), *Stegophorus* sp. (3,3%) e *Tetrameres skrjabini* (3,3%). Com exceção de *P. altmani*, este é o primeiro relato desses helmintos parasitando gaivotas-de-Franklin.

Palavras-chave: Acari, aves marinhas, helmintos, Phthiraptera, Laridae.

Introduction

The Franklin's gull, *Leucophaeus pipixcan* (Wagler, 1831), is a migratory bird that travels every year from breeding sites in the United States and Southern Canada (Harrison, 1983) to Central and South America; most individuals stay in the southern hemisphere during the austral summer (Marin & Couve, 2001). Its presence on the Chilean coasts is observed from Arica (18°28'S, 70°17'W) to the extreme south of the country, Aysén (45°24'S, 72°42'W), with accidental records in the Magellan and Antarctic Regions (Couve et al., 2016).

Most studies of parasitic fauna in the Franklin's gull concern ectoparasites. To date, four species of lice have been found in the Franklin's gull: *Saemundssonina lari* (Fabricius, 1780), *Quadriceps punctatus* (Burmeister, 1838), *Actornithophilus piceus lari* (Packard, 1870) and *Austromenopon transversum* (Denny, 1842), recorded in the Neotropical region and Northern hemisphere (Emerson, 1972; Palma, 1995; Hellenthal et al., 2004; González-Acuña et al., 2006, 2011; Galloway et al., 2014; Gomez-Puerta & Cribillero, 2015). In addition, the nasal mite *Turbinoptes strandtmanni* Boyd, 1949 and feather mites of the genera *Alloptes* Canestrini, 1879, *Zachvatkinia* Dubinin, 1949 and *Ingrassia* Oudemans, 1905 were reported from this host in North America (Galloway et al., 2014; Knee & Galloway, 2016).

Regarding its endoparasites, there are records of the acanthocephalan *Profilicollis altmani* (Perry, 1942) Van Cleave, 1947 (= *P. bullocki*), isolated from this host in South America (Peru and Chile) (Tantaleán et al., 2005; Riquelme et al., 2006; Rodríguez et al., 2017), and the filarioid nematode *Eulimdana* sp. in Canada (Bartlett, 1992). Despite its wide geographical distribution, reports on its parasitic fauna are scarce, and knowledge about its internal parasites is quite limited. This study aims to provide new records of diversity and prevalence of parasites associated with the Franklin's gull.

Materials and Methods

The study was carried out in Talcahuano, a coastal city in central Chile (36°44'10"S, 73°06'17"W) (Figure 1), during January and February 2008 and March 2009. Sixty Franklin's gulls were captured with modified Bal-chatri traps pre-baited with fish. Captured gulls were visually examined, inspecting their feathers and skin for ectoparasites, which were collected and preserved in 70 GL ethanol. Half of the individuals were released, and the rest were euthanized by cervical dislocation. All procedures were authorized by the Agricultural and Livestock Service (SAG) under the resolutions No 1801 and 811.

The 30 dead birds were stored in plastic bags and immediately taken to the laboratory for parasitological necropsy. The extracted feather lice were cleared and mounted in Canada balsam, as described by Palma (1978) and Price et al. (2003). Mites were cleared in Nesbitt's solution for 72 hours and mounted in Berlese's solution, as described by Krantz & Walter (2009). The identification of lice followed the taxonomic keys by Clay (1949, 1959, 1962), Price & Clay (1972), Timmermann (1952), and Ward (1955); for mites, the keys by Gaud & Atyeo (1996), and Mironov (1989) were applied.

Bird dissection and endoparasite collection followed the necropsy technique described by Oyarzún-Ruiz & González-Acuña (2020). Trematodes and cestodes were fixed with 70° ethanol and stained with Alum Carmine stain; and finally, nematodes and acanthocephalan were fixed in ethanol 70° and later cleared in lactophenol. For the identification of helminths, the keys proposed by Anderson et al. (2009), Khalil et al. (1994), Yamaguti (1958, 1959, 1961, 1963) and Baruš et al. (1978) were followed. Parasitological descriptors such prevalence, mean intensity, range and mean abundance were calculated according to Bush et al. (1997).

Results and Discussion

Phthiraptera

Lice were recorded on 53.3% (32/60) of gulls, corresponding to four species (Figure 2a, 2b, 2c, 2d): *Actornithophilus piceus lari* (Amblycera: Menoponidae) was collected from the wings of 15% (9/60) of the individuals, with a total of 17 specimens (Table 1). The genus *Actornithophilus* is exclusive to the order Charadriiformes (Clay, 1962; Price et al.

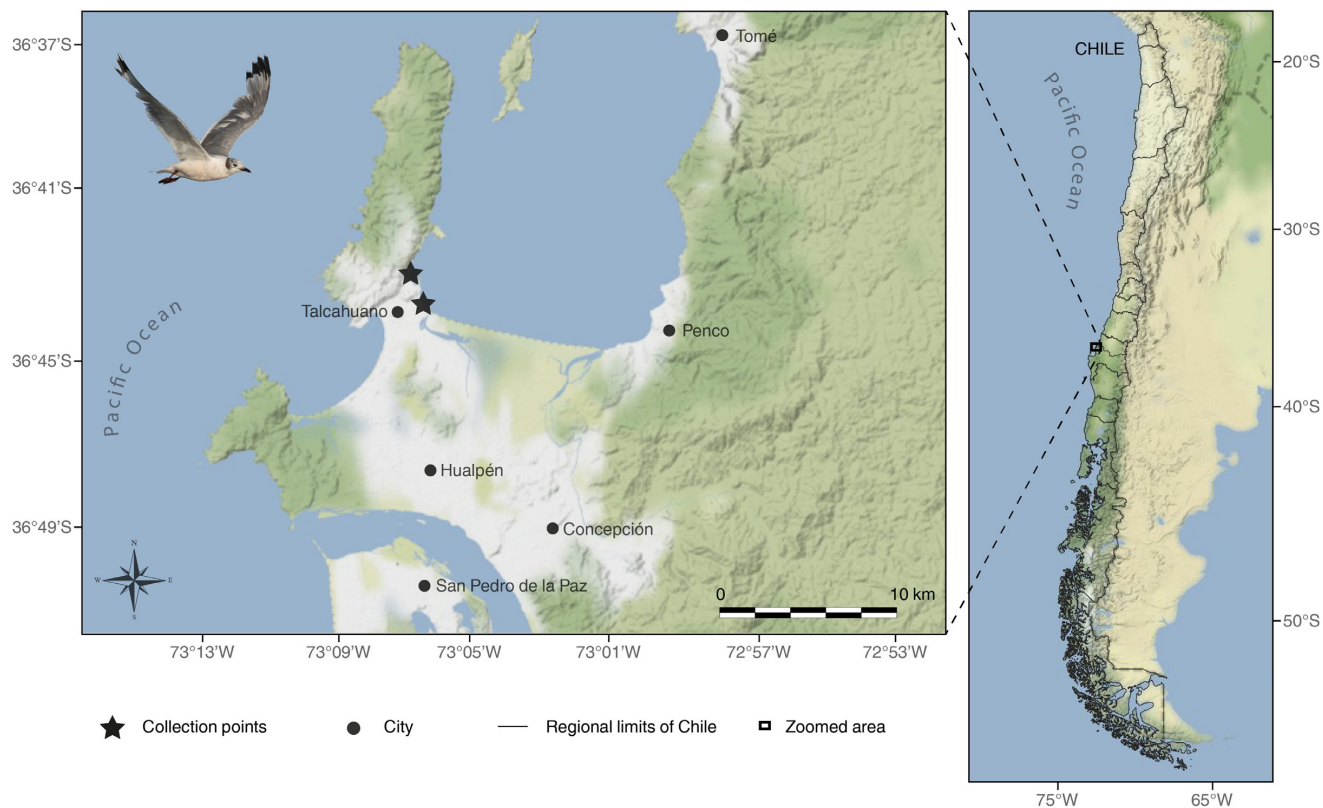


Figure 1. Sampling locations of Franklin's gull in Talcahuano, central Chile.

Table 1. Summary of external parasites found in 60 Franklin's gulls (*Leucophaeus pipixcan*) from Talcahuano, central Chile.

Species	Location (feathers)	Prevalence (%)	Range	Mean intensity	Mean abundance	Total parasites
Phthiraptera						
<i>Actornithophilus piceus lari</i>	Wings	15.0	1-4	1.9	0.3	17
<i>Austromenopon transversum</i>	Body	6.7	1-3	2	0.13	6
<i>Quadraceps punctatus</i>	Wings	10.0	1-3	1	0.10	8
<i>Saemundssonina lari</i>	Head/neck	46.7	1-17	3.8	46.7	106
Acari						
<i>Zachvatkinia larica</i>	Primaries	43.3	2-969	156.9	43.3	4080

2003), while the cosmopolitan subspecies *A. piceus lari* is restricted to the family Laridae, being reported from the genera *Larus*, *Pagophila*, *Rhodostethia*, *Rissa*, *Xema* and *Leucophaeus* (Emerson, 1972; Price et al. 2003). This report adds *A. piceus lari* to the list of parasites of *L. pipixcan*.

Austromenopon transversum (Amblycera: Menoponidae) was collected with a prevalence of 6.7% (4/60), the lowest among lice detected (Table 1). These parasites were isolated from the chest and belly of the individuals, with a total of six specimens. Lice of the genus *Austromenopon* have been reported as parasites of, Charadriiformes, Pelecaniformes and Procellariiformes (Clay, 1959; Price & Clay, 1972; Pilgrim & Palma, 1982). *Austromenopon transversum* has been mainly isolated from gulls of the genus *Larus* (Price et al., 2003). This finding adds to the reports of parasitism of *A. transversum* on Franklin's gull, recorded in Europe (Belgium) (Hellenthal et al., 2004), North America (Emerson, 1972; Galloway et al., 2014) and South America (Chile) (González-Acuña et al., 2011).

Quadraceps punctatus (Ischnocera: Philopteridae) was collected from the wings with 10.0% (6/60) of prevalence, presenting the lowest mean intensity and mean abundance of lice (Table 1). The cosmopolitan genus *Quadraceps* is composed of a wide variety of species and subspecies that parasitize birds of the order Charadriiformes (Price et al.,

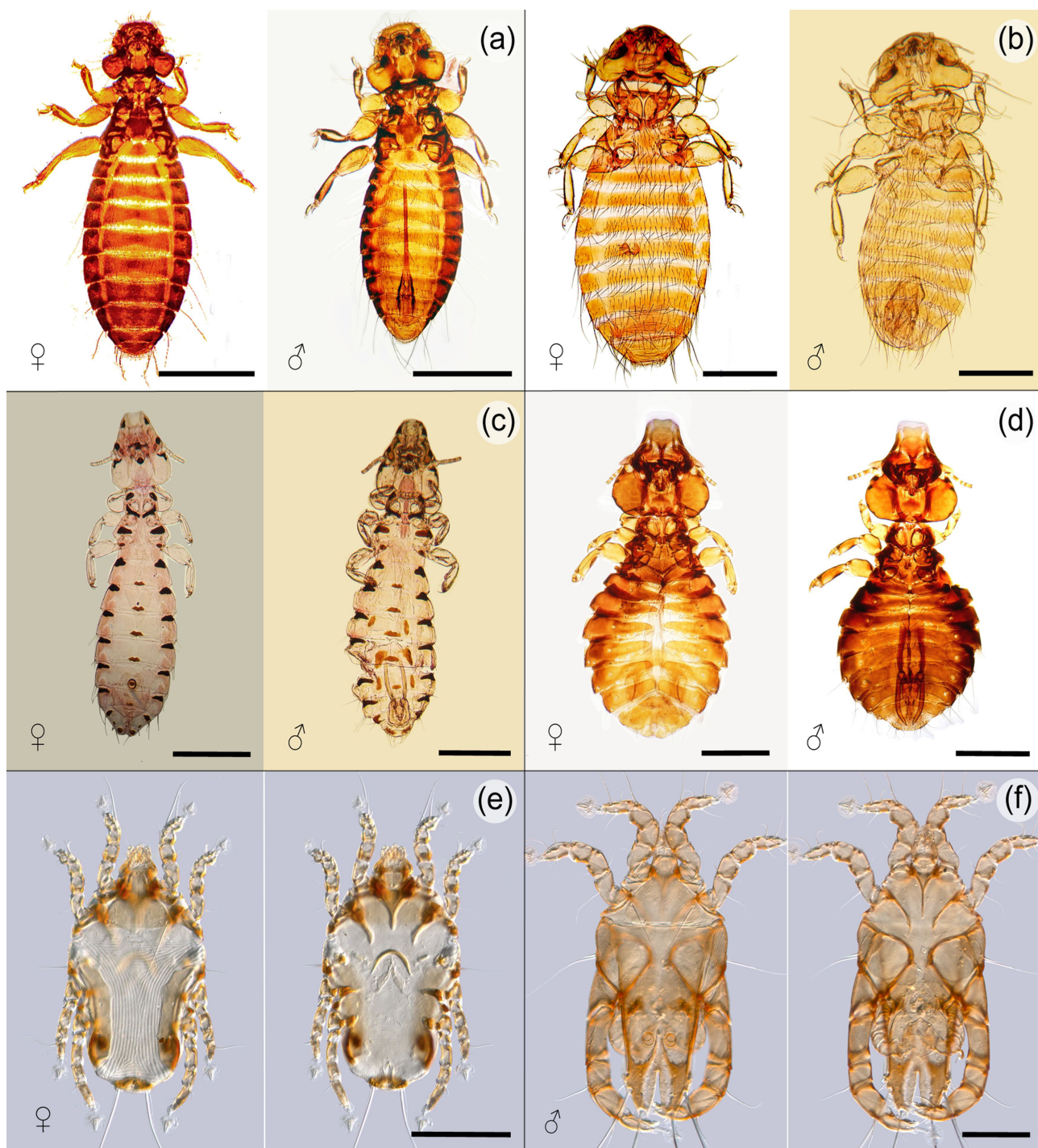


Figure 2. Ectoparasites recorded on Franklin's gull from Talcahuano, Chile. Lice (a-d). (a) *Actornithophilus piceus lari*. Scale bars= 1 mm; (b) *Austromenopon transversus*. Scale bars= 500 µm; (c) *Quadriceps punctatus*. Scale bars= 500 µm; (d) *Saemundsonia lari*. Scale bars= 500 µm. Mites (e-f); (e) *Zachvatkinia larica* female, dorsal view (left), ventral view (right). Scale bar= 200 µm; (f) *Z. larica* male, dorsal view (left), ventral view (right). Scale bar= 200 µm.

2003). *Quadriceps punctatus* has been frequently recorded on birds of the family Laridae, mainly in those of the genus *Larus*, with records from the Palearctic, Nearctic and Neotropical regions, also Australasia (Timmermann, 1952; Price et al., 2003). *Quadriceps punctatus* is one of the four lice species identified as parasites in *L. pipixcan*, being previously reported in Canada (Galloway et al., 2014), Belgium (Hellenthal et al., 2004), Galapagos (Palma, 1995), and Chile (González-Acuña et al., 2011). In Chile, this louse has also been isolated from the gulls *Larus dominicanus* and *L. modestus* (González-Acuña et al., 2011).

Saemundssonina lari (Ischnocera: Philopteridae) was collected from the head and chin regions with 46.7% (28/60) of prevalence, and a total of 106 specimens (Table 1). Lice of the genus *Saemundssonina* inhabit preferentially the head of their hosts (Johnson et al., 2012; Yamagishi et al., 2014). Morphologically, it has a triangular anterior margin with a rostral groove, the common characteristic of head lice, that helps them hold on feathers and resist against scratches (Price et al., 2003; Johnson et al., 2012). *Saemundssonina lari* was the most prevalent parasite in this study, with the highest mean abundance, that presumably related to its capability ecological niche occupied to resist to grooming (Johnson et al., 2012). This cosmopolitan species parasitizes birds of the family Laridae, with reports in those of the genera *Gabianus*, *Larus*, *Pagophila*, *Rissa* and *Xema* (Price et al., 2003; Vas et al., 2012), and has been previously recorded from *L. pipixcan* in Belgium (Hellenthal et al., 2004), Canada (Galloway et al., 2014), Peru (Gomez-Puerta & Cribillero, 2015), and Chile (González-Acuña et al., 2006, 2011).

Acari

The feather mite *Zachvatkinia larica* Mironov, 1989 (Acari: Avenzoariidae) was found on 43.3% (26/60) of the gulls examined (Figure 2e, 2f). This mite had the highest mean intensity among other ectoparasites (Table 1), with 4080 specimens collected from vanes of primaries, secondaries, and rectrices. The predilection for these microhabitats in the plumage has been previously documented for mites of the genus *Zachvatkinia* Dubinin, 1949 (Mironov, 1989; Dabert & Mironov, 1999; Bridge, 2003; Dabert et al., 2015), assuming that their location in relatively exposed areas could facilitate transmission of mite individuals between host individuals (Dabert et al., 2015). This feather mite genus, which is specifically associated with gulls, terns (Charadriiformes: Laridae), crab plovers (Charadriiformes: Dromadidae), and with Procellariiformes (Mironov, 1989; Gaud & Atyeo, 1996; Negm et al., 2013), is usually very abundant on their hosts (Mironov & Stefan, 2013), as well as in this report. *Zachvatkinia larica* has been isolated from various gull genera (Larinae) in Russia (Mironov, 1989), Netherlands (Siepel et al., 2016), North America (Galloway et al., 2014; Beltrán-Ontiveros & Vergara-Pineda, 2016), Colombia (Barreto et al., 2012) and Korea (Han et al., 2016). In addition, this mite was reported for the first time as a parasite in *L. pipixcan* by González-Acuña et al. (2011) in the same locality of the present study.

Trematodes

Aporchis sp. (Digenea: Echinostomatidae) was collected from the small intestine of two individuals with a prevalence of 6.7% (Table 2, Figure 3a). The genus *Aporchis* (Stossich, 1905) has a wide geographical distribution being associated with seabirds, and was previously registered in the Palearctic (Bosch et al., 2000; Roca et al., 2001; Santoro et al., 2011; Radwan, 2014), Nearctic (McCauley & Pratt, 1960; Hoberg, 1981) and Neotropical regions (González-Acuña et al., 2009). In Chile, this genus was found in the Kelp gull, *L. dominicanus*, by González-Acuña et al. (2009), with which the Franklin's gull shares habitats during the southern summer, and it is still unknown what other gull species could act as a host in the area. The specific identification could not be achieved because the peristomic disc of specimens lack of their spines which are required for its diagnosis (Yamaguti, 1958). *Aporchis* sp. in *toto* is shown in Figure 3a. Its narrower forebody is indicated by the right arrowhead; at the anterior end, the peristomic disc is indicated by an asterisk and the left arrowhead shows the acetabulum. The present study represents the first report of the genus *Aporchis* in *L. pipixcan*, expanding its host range.

Cestodes

The species *Tetrabothrius cylindraceus* (Rudolphi, 1819) (Tetrabothriidea: Tetrabothriidae) was isolated from the small intestine of 17 birds, with a prevalence of 56.7% (Table 2; Figure 3b). The genus *Tetrabothrius* includes more than 50 species parasitizing seabirds and marine mammals. Both groups act as definitive hosts, while crustaceans, fishes, and cephalopods are intermediate hosts (Hoberg, 1989). This parasite has been recorded in various birds of the order Charadriiformes (Alcidae, Stercorariidae, Laridae) from Europe (Roca et al., 2001; Santoro et al., 2011; Haukisalmi, 2015; Parejo et al., 2015), Asia (Uchida et al., 2005; Kuklin, 2011), North America (Threlfall, 1968; Muzaffar, 2009), South America (Argentina and Chile) (González-Acuña et al., 2009; Diaz et al., 2011), and Antarctica (Barbosa & Palacios, 2009; Rocka, 2019). In Latin America, it has been isolated from the gull *L. dominicanus* in Chile (Torres et al., 1991, 1992, 1993; González-Acuña et al., 2009) and later from the same host in Argentina (Diaz et al., 2011). Despite being a common parasite in seagulls, this study presents the first record of *T. cylindraceus* in *L. pipixcan* worldwide.

Table 2. Summary of endoparasites found in 30 Franklin's gulls (*Leucophaeus pipixcan*) from Talcahuano, central Chile.

Species	Location	Prevalence (%)	Range	Mean intensity	Mean abundance	Total parasites
Trematoda						
<i>Aporchis</i> sp.	Small intestine	6.7	4-6	5	0.3	10
Cestoda						
<i>Tetrabothrius cylindraceus</i>	Small intestine	56.7	1-7	1.8	1	30
Cyclophyllidea gen. sp.	Small intestine	3.3	2	2	0.1	2
Acanthocephala						
<i>Profilicollis altmani</i>	Small intestine	56.7	1-34	10.1	5.7	171
Nematoda						
<i>Eucoleus contortus</i>	Esophagus	10	1-2	1.7	0.2	5
<i>Cosmocephalus obvelatus</i>	Esophagus/ proventriculus	13.3	1-5	1.7	0.2	7
<i>Paracuaria adunca</i>	Proventriculus/ gizzard	10	1-3	1.7	0.2	5
<i>Stegophorus</i> sp.	Gizzard	3.3	1	1	0.03	1
Acuariidae gen. sp. (larva)	Gizzard	3.3	1	1	0.03	1
<i>Tetrameres skrjabini</i>	Esophagus/ proventriculus	3.3	-	7	0.2	7

A few cyclophyllidean tapeworms were isolated from the small intestine of gulls with a prevalence of 3.3% (1/30) (Table 2). However, its specific identification could not be achieved because the poor preservation of proglottids and loss of rostellar hooks. The scolex is shown in Figure 3b, where the arrowhead indicates its four semi-circular suckers.

To our knowledge, the only record of a cyclophyllidean tapeworm in the Franklin's gull corresponds to *Retinometra caballeroi* (Flores-Barroeta, 1953) (syn. *Aploparaksis caballeroi*) (Hymenolepididae), which was reported by first time in Panama (Bondarenko & Kontrimavichus, 2018). Furthermore, other genera of family Dilepididae (e.g. *Alcataenia* and *Anomotaenia*) have been recorded in other gulls such *L. dominicanus* and brown-hooded gull *Chroicocephalus maculipennis* from Chile (Torres et al., 1991, 1992, 1993; González-Acuña et al., 2009) and other South American (Diaz et al., 2011) and European countries (Sanmartín et al., 2005; Álvarez et al., 2006; Sagerup et al., 2009; Santoro et al., 2011). Also, other cyclophyllidean genera such *Aploparaksis* (Aploparaksidae), *Nadejdolepis*, *Microsomacanthus* and *Wardium* (Hymenolepididae) have been recorded in gulls around the world (Khalil et al., 1994; González-Acuña et al., 2009; Sagerup et al., 2009; Bondarenko & Kontrimavichus, 2018). Additional surveys are required to establish the identity of these tapeworms.

Acanthocephala

Profilicollis altmani (Polymorphida: Polymorphidae) was the only acanthocephalan found in this study, collected from the small intestine of 56.7% (17/30) of gulls (Table 2; Figure 3c). Figure 3c shows an individual of *P. altmani* with its spherical proboscis (right) and in detail (upper left side) the rows of small hooks present on the surface of this structure (indicated by asterisks).

This parasite has an indirect life cycle with decapod crustaceans as intermediate hosts; *Emerita analoga* (Stimpson, 1857) and *Hemigrapsus crenulatus* (Milne-Edwards, 1837) (Balboa et al., 2009; González-Acuña et al., 2009), both widely distributed along the coast of Chile (Retamal, 1981). *Profilicollis altmani* has been reported in Charadriiformes from the Neotropical region (Tantaleán et al., 2005; Riquelme et al., 2006; González-Viera et al., 2009; González-Acuña et al., 2017; Rodríguez et al., 2017; Gomez-Puerta & Naupay, 2019), being previously isolated from Franklin's gulls in northern and central Chile and Peru (Tantaleán et al., 2005; Riquelme et al., 2006; Rodríguez et al., 2017),

areas where it has also been recorded on its intermediate hosts and sympatric birds (Riquelme et al., 2006; Iannaccone et al., 2007; Balboa et al., 2009). The present study provides a new report of this parasite-host association in central coasts of Chile, where *L. pipixcan* has been shown to be a better host that increases the abundance of *P. altmani* when it arrives to this area (Riquelme et al., 2006).

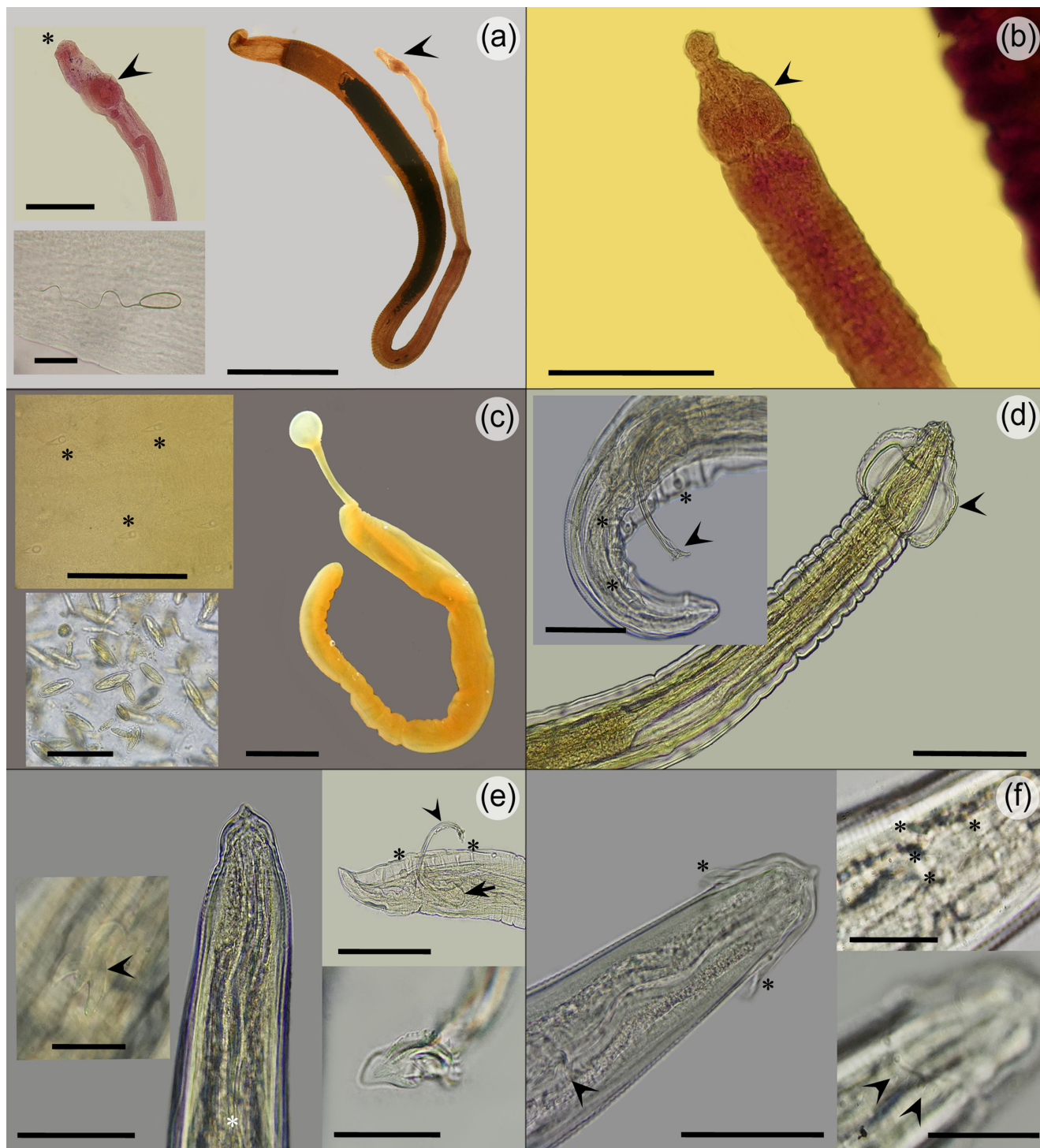


Figure 3. (a) *Aporchis* sp., *in toto*. Right, scale bar= 2 mm. Upper left side, scale bar= 500 µm. Egg with its unique polar filament. Bottom left side, scale bar= 125 µm; (b) *Tetrabothrius cylindraceus*. Scale bar= 250 µm; (c) *Profilicollis altmani*, worm *in toto*. Right, scale bar= 5 mm. Upper left side, scale bar= 250 µm. Elongated eggs. Bottom left side, scale bar= 125 µm; (d) *Cosmocephalus obvelatus*. Scale bar= 250 µm. Upper left side, scale bar= 125 µm; (e) *Paracuaria adunca*. Central image, scale bar= 125 µm. Left, scale bar= 30 µm. Upper right side, scale bar= 250 µm. Bottom right side, scale bar= 30 µm; (f) *Stegophorus* sp. Left, scale bar= 60 µm. Upper right side, scale bar= 30 µm. Bottom right side, scale bar= 30 µm.

Nematodes

Eucoleus contortus (Creplin, 1839) (Enoplida: Capillariidae) was collected from the esophagus of three individuals, with 10% (3/30) prevalence (Table 2). This nematode is frequently found in the esophagus of a wide variety of aquatic birds such as gulls, grebes, cormorants and ducks in Europe (Bosch et al., 2000; Sanmartín et al., 2005; Álvarez et al., 2006; Santoro et al., 2011), North America (Fedynich et al., 1997; Threlfall et al., 1982), Asia (Yoshino et al., 2009), and South America (Brazil and Chile) (Monteiro et al., 2011; González-Acuña et al., 2017; Carvalho et al., 2019). *Eucoleus contortus* was reported for the first time in Chile parasitizing *Podiceps occipitalis* (Podicipedidae) (González-Acuña et al., 2017); it is suspected that it could be an accidental infestation because of sharing the habitat with potential hosts. This study provides the first record of *E. contortus* in *L. pipixcan* globally, expanding its host range.

Cosmocephalus obvelatus (syn: *C. firlotlei*) (Creplin, 1825) (Spirurida; Acuariidae) was collected from the esophagus and proventriculus of 13.3% (4/30) of the individuals (Table 2, Figure 3d), the usual location, since larvae initially invade the proventriculus and later settle in the esophagus (Wong & Anderson, 1982a). Figure 3d shows the anterior end of an individual of *C. obvelatus*, the arrowhead indicates the cephalic cordons. On the upper left side is shown the posterior end of a male worm. The asterisks are indicating the pre-anal and post-anal papillae, on the ventral surface, and the arrowhead indicates the left spicule, which is triangular at its distal border.

The life cycle of this species includes amphipod crustaceans and fishes as intermediate and paratenic hosts, respectively (Wong & Anderson, 1982a; Anderson, 2000). This nematode has been reported in a wide variety of piscivorous birds (Sphenisciformes, Charadriiformes, Anseriformes, Pelecaniformes, Procellariiformes, Podicipediformes, Gaviiformes, and Ciconiiformes) from all continents except Antarctica (Anderson & Wong, 1981; Sanmartín et al., 2005; Álvarez et al., 2006; Mutafchiev et al., 2010; Santoro et al., 2011). In the southern cone of Latin America, it has been isolated from the penguins *Spheniscus humboldti* (Spheniscidae) (Fernández et al., 2019), *Spheniscus magellanicus* (Spheniscidae) (Diaz et al., 2001, 2010), the generalist raptor *Milvago chimango* (Falconidae) (Oyarzún-Ruiz et al., 2016) and *L. dominicanus* (González-Acuña et al., 2009; Diaz et al., 2011). *Cosmocephalus obvelatus* has been described in the American continent from larids sympatric to the Franklin's gull, including *Rissa tridactyla*, *Larus californicus*, *Larus delawarensis*, *Larus hyperboreus*, *Larus marinus*, and *L. dominicanus* (Rodrigues de Olivera & Vicente, 1963; Threlfall, 1968; Anderson & Wong, 1981; González-Acuña et al., 2009; Diaz et al., 2011; Hannon et al., 2016). This is the first report worldwide of this nematode parasitizing *L. pipixcan*.

Paracuaria adunca (Creplin, 1846) (Spirurida; Acuariidae) was isolated in the 10% (3/30) of birds (Table 2; Figure 3e). These nematodes were collected from the proventriculus and under the koilin layer of gizzard, which is in agreement with Anderson & Wong (1982) and Wong & Anderson (1982b). Figure 3e shows an individual of this species. In the center of the figure, is shown the anterior part of the worm with its two pseudolabia and striated cuticle. The position of the deirid is posterior to the nerve ring (white asterisk) and its tridentate shape is shown in detail on the left picture. The posterior end of male worm (upper right side) has 2 dissimilar spicules; right spicule is short and stout, rounded at its basis (arrow), and left spicule is long, slender (arrowhead) and presents a triangular and serrated distal tip, shown in detail on the bottom right side.

Through experimental studies, Anderson & Wong (1982) showed that amphipod crustaceans and fishes act as a source of transmission for *P. adunca*, with the latter group as the main source of infection in seagulls. Due to the above, this nematode mainly parasitizes piscivorous birds as has been reported in Europe, Asia, North America, South America and Cuba (Baruš et al., 1978; Wong & Anderson, 1982b; Diaz et al., 2004, 2011; Sanmartín et al., 2005; Álvarez et al., 2006; Santoro et al., 2011; Hannon et al., 2016). In Chile, it has been documented for the first time in the raptor *M. chimango* that is attributable to its piscivorous food habits (Oyarzún-Ruiz et al., 2016), and in the Kelp gull, *L. dominicanus*, (González-Acuña et al., 2009), a host species for which exists other records in Latin America (Diaz et al., 2004, 2011). To our knowledge, this is the first report of the Franklin's gull as a host of this nematode.

Stegophorus sp. (Spirurida: Acuariidae) and other unidentified acuariid larva were isolated under the koilin layer of the gizzard from two different gulls, both with a prevalence of 3.3% (1/30) (Table 2; Figure 3f). The specific diagnosis for *Stegophorus* could not be achieved because the isolated specimen corresponded to an immature female worm (Anderson et al., 2009). Figure 3f shows the only specimen of *Stegophorus* sp. isolated. On the left is shown the anterior end with two pseudolabia covered at its posterior border by teeth (asterisks). The position of the deirid is over the union between the buccal capsule and muscular esophagus (arrowhead), it has a rounded tridentate shape shown bordered by asterisks on the right side. Detail of pseudolabia, which appears as a collarete with several teeth, are indicated on the bottom right side by arrowheads.

This genus has been reported previously in several piscivorous birds such orders Procellariiformes, Sphenisciformes and Charadriiformes (Baruš et al., 1978; Mutafchiev et al., 2014). Those species reported parasitizing

charadriiform birds (e.g. the genera *Larus* and *Stercorarius*) are the following: *Stegophorus arctowskii* Zdzitowiecki & Drózd, 1980, *Stegophorus macronektes* (Johnston & Mawson, 1942), *Stegophorus stellaepolaris* (Parona, 1901) and *Stegophorus stercorarii* Leonov, Sergeeva & Tsimbalyuk, 1966 (Sagerup et al., 2009; Mutafchiev et al., 2014). These parasites, like other acuariid nematodes, are probably transmitted mostly by consumption of fishes which could act as paratenic hosts (Anderson & Wong, 1982; Wong & Anderson, 1982a; Anderson, 2000). To our knowledge, the present record of the genus *Stegophorus* is the first for the Franklin's gull.

Tetrameres skrjabini (Panova, 1962) (Spirurida: Tetrameriidae) was isolated from a single gull with a prevalence of 3.3% (1/30) (Table 2). One male specimen was found in the esophagus lumen, and seven females were found into the proventriculus glands, location typically adopted by this genus in the case of females, but not males, who are usually found on the lumen or mucosa of the proventriculus (Kinsella & Forrester, 2008). This genus has an indirect life cycle, with crustaceans acting as intermediate hosts in aquatic environments (Anderson, 2000; Kinsella & Forrester, 2008), while birds of the orders Anseriformes, Ardeiformes, Gruiformes and Charadriiformes act as definitive hosts (Mollhagen, 1976; Kinsella & Forrester, 2008). In spite of the above, *T. skrjabini* has been reported more frequently in birds of the subfamilies Sterninae and Larinae (Mollhagen, 1976), with reports in Europe (Sanmartín et al., 2005; Álvarez et al., 2006; Kavetska et al., 2012; Parejo et al., 2015), Asia, North America (Mollhagen, 1976) and South America (González-Acuña et al., 2009). In the Neotropical region, it has only been isolated from *L. dominicanus* in south-central Chile (González-Acuña et al., 2009). The latter locality is close to that of the present study, where it lives in sympatry with *L. pipixcan* (González-Acuña et al., 2011). This is the first report of this nematode as a parasite of *L. pipixcan* worldwide.

Conclusion

The present study contributes to the current knowledge on the diversity of parasites associated with Franklin's gulls, reporting for this host five ectoparasites (feather mites and chewing lice) and nine gastrointestinal parasites. New host-parasite associations are reported, including the following helminths: Cyclophyllidea gen. sp., *Aporchis* sp., *Eucoleus contortus*, *Cosmocephalus obvelatus*, *Paracuaria adunca*, *Stegophorus* sp., and *Tetrameres skrjabini* as endoparasites of *L. pipixcan*.

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